DAB FIELD TEST PROJECT ANTENNA CHARACTERIZATION REPORT

submitted to:

NRSC/EIA/NAB Field Test Task Force

July 9, 1996

prepared by:
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Audio Systems Engineering
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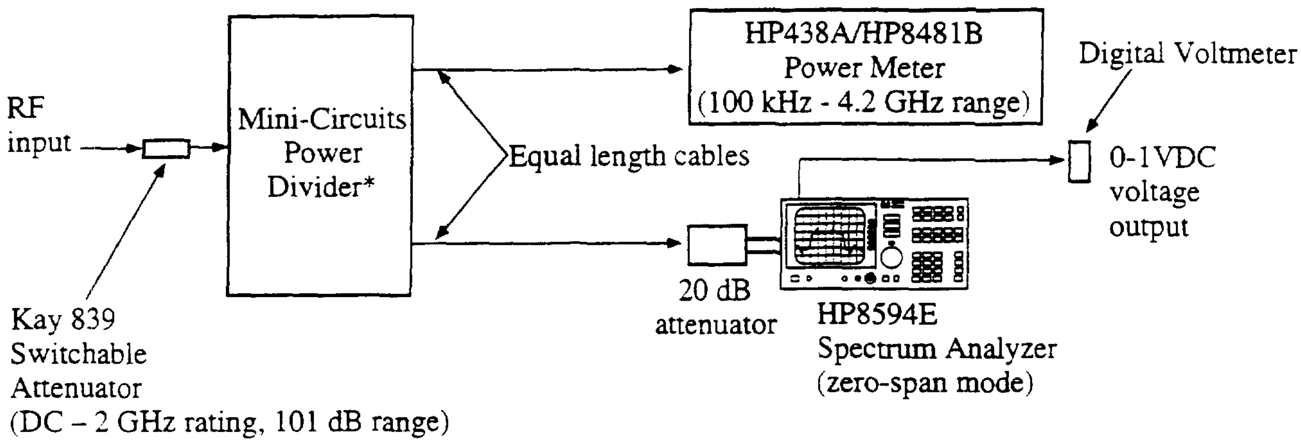
NOTE: Copies of this report are available from Ralph Justus at EIA.

DAR Power Calibration
Block Diagram



RF Input Characteristics

System	Frequency	Source
AT&T/Lucent IBAC	96.9 MHz	Output of system rack through IPA
Eureka 147	1468	EU147 Itis/Telefunken encoder/modulator
VOA/JPL	60	Modem IF output (using VOA/JPL S-band upconverter as source; internal generator mode)

* Mini-circuits Type ZFSC-2-1W power divider used for AT&T/Lucent and VOA/JPL; Type ZA3PD-2 power divider used for Eureka 147, with unused output terminated.

HAMMETT & EDISON, INC.
CONSULTING ENGINEERS
SAN FRANCISCO

	AT&T/Lucent IBAC			Eureka 147			VOA/JPL		
Attenuator Setting	Power-meter Reading	Zero-Span Analyzer	DC voltage	Power-meter Reading	Zero-Span Analyzer	DC voltage	Power-meter Reading	Zero-Span Analyzer	DC voltage
0 dB	-12.6 dBm	-33 dBm	0.921 V	-7.04 dBm	-37 dBm	0.819 V			
3	-15.6	-36	0.882	-10.1	-40	0.780			
6	-18.6	-39	0.844	-13.1	-43	0.742			
9	-21.6	-43	0.803	-16.0	-46	0.705			
12	-24.5	-46	0.766	-19.4	-49	0.663	-9.55 dBm	-31 dBm	0.943 V
15	-27.4	-49	0.728	-22.2	-52	0.627	-12.6	-34	0.905
18	-30.3	-52	0.690	-25.1	-55	0.588	-15.6	-37	0.867
20	-31.9	54	0.664				-17.6	-39	0.833
21				-27.9	-58	0.553	-18.6	-40	0.827
24				-30.8	-61	0.515	-21.6	-43	0.789
27				-34.0	-64	0.474	-24.4	-46	0.750
30	-37.8	-64	0.536	-36.7	-67	0.435	-27.3	-49	0.712
40		74	0.408		-70	0.316		-59	0.583
50		-84	0.283		80	0.232		-69	0.455
60		-94	0.172		-90	0.208		-79	0.328
70		-97	0.119		-90	0.205		-89	0.210
80								-95	0.131

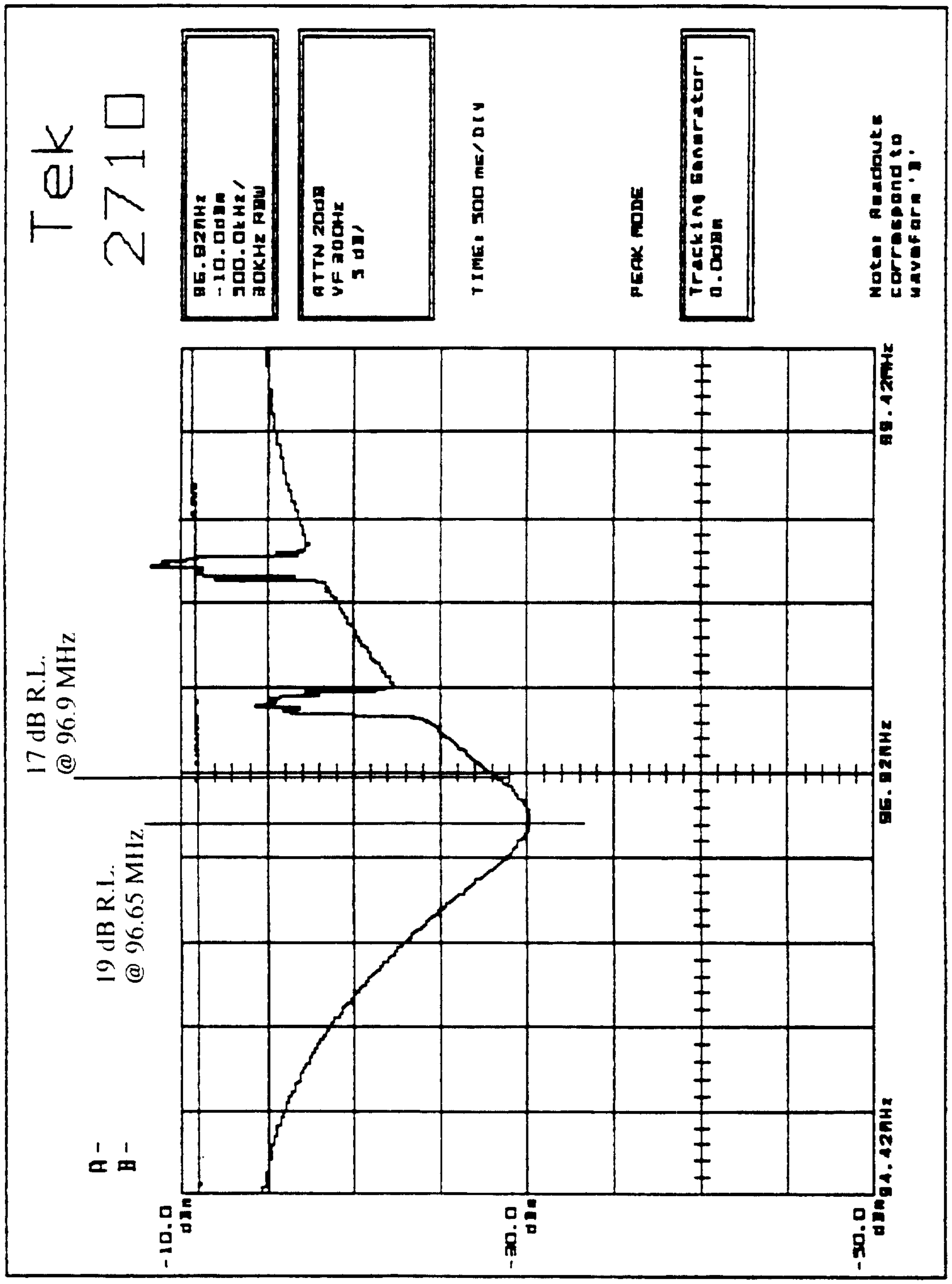
Notes

1. Power meter readings are not adjusted to reflect the 20 dB attenuator in the zero span spectrum analyzer path. Subtract 20 dB from power meter readings to equalize.
2. Power meter readings become inaccurate/unstable for levels below about -25 dBm, as reported above.
3. Zero-span spectrum analyzer readings become inaccurate/unstable for levels below about -90 dBm, as reported above.

Electronic Industries Association • Consumer Electronics Manufacturers Association

Swept Return Loss Measurement of KEIA Transmitting Antenna

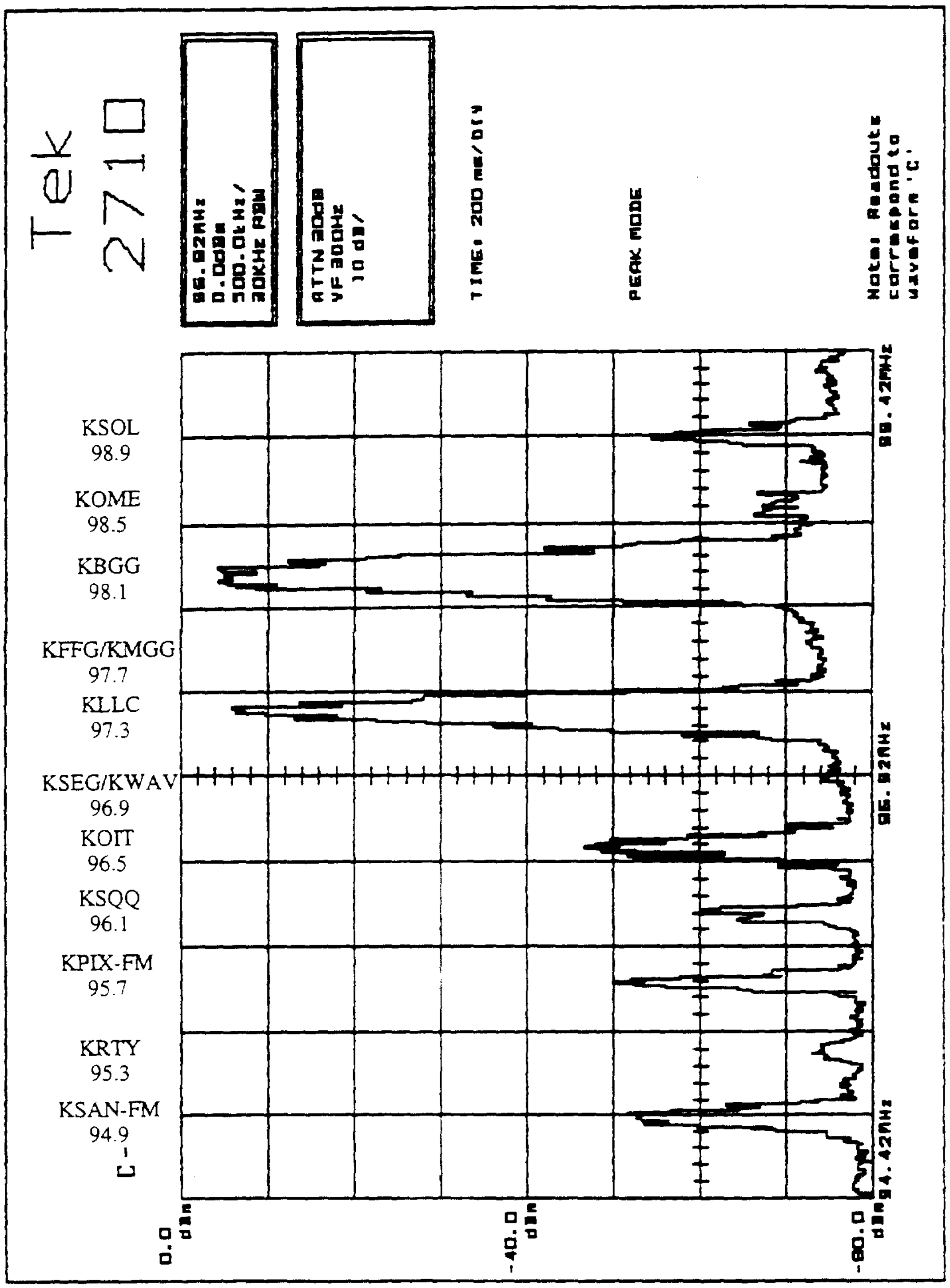
Measurement conducted on November 11, 1996 by William Ruck
using Tektronix Model 2710 Spectrum Analyzer
and custom directional coupler



961214
Figure 1

KEIA Transmitting Antenna Used for Reception through 30 dB Attenuator

Measurement conducted on November 11, 1996 by William Ruck
using Tektronix Model 2710 Spectrum Analyzer



961214
Figure 2

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Audio Event descriptions

TRANSCRIBED FROM;

DAB SUBCOMMITTEE - FIELD TEST TASK GROUP
Approved Minutes of May 11, 1995 Meeting, Page 3.

"Signal Quality Assessment by Test Personnel. After replaying some of the discussion from the last meeting for the benefit of Messrs. Goldman and Justus, who were absent at that meeting, the Group agreed on the following:

Reception notes will have two decision points (as indicated by two buttons) between listenable and unlistenable, and between unlistenable and no audio. The two buttons used to indicate that the unlistenable or no audio conditions exist will be of the momentary contact type, and the assessor will keep a finger on the appropriate button throughout the duration of the "unlistenable" or "no audio" condition. "Listenable" was defined to mean a signal that an average listener would continue listening to and "unlistenable" was defined to mean a signal that an average listener would tune out (because of poor signal quality)."

DAR Field Test Observer Training Script

The following text was read at the beginning of each field test day to persons acting as DAR observers. All observer questions were resolved before the commencement of test runs.

We've asked you here to help us test digital radio systems. Digital radio is different than the analog AM and FM radio that you're used to–instead of hearing the signal gradually fade away into static or interference, a digital radio may just cut out completely when it's not receiving a strong enough signal. Generally, this means that with digital radios, you're either receiving perfect audio or nothing at all. With some systems, however, the program audio can become garbled if the receiver gets confused when trying to make sense of the digital information it's picking up. These defects can sound like gurgling, scratches, popping, or a brief repeat of the program audio.

So what we need you to do is mark the points where these two kinds of events occur: audio dropouts and audio defects. We've set up these two game pads for you to use as markers; as we drive around, press the red button when you hear the audio drop out and the yellow button when you hear some kind of defect in the audio. The dropouts should be fairly easy to catch, but the defects may be a bit tricky depending on the kind of music that's playing at the time. If you're not sure if something you hear is part of the music or an event, mark it and ask me about it, because I'll be listening as well. Try to mark the events as close as possible after you hear them, but we understand that there will be some delay. Above all, try to mark every defect that you hear.

This tape is from an actual run that we've made, and it shows fairly clearly the things that you'll be listening for. Listen through these headphones: you each have an independent control so you can adjust the volume to a comfortable level.

(Play first 2-3 minutes of training tape; discuss differences between defects and dropouts, ask for any questions.)

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Field Test Procedure

Pre-Test System Startup and Calibration

Prior to the start of each day's field testing, the test van was removed from the staging area while connected to shore power, any prestriped tapes from the previous night were removed from the data recorders, and the equipment and UPS units were shut down. Antennas required for the proponent system under test were installed and the configuration of the RF test bed and audio patch bays were modified accordingly. The shore power cable was then stowed in its compartment, the staging area was secured, and the test van was driven to a nearby service station. The van's fluid levels and tire pressure were checked and the fuel tank was filled.

The van was then driven to a nearby parking lot where the generators and UPS units were started. All test equipment was then powered up and checked for proper operation. At this time, if necessary, the observers were read the training text and listened to a sample tape of the system under test. Since the parking lot has a clear line-of-sight to the transmission site, it was also used as a calibration point for the Eureka 147 system in both SFN and single transmitter modes. The Eureka 147 receiver was activated and checked for proper operation, and then a fixed attenuator provided by DRRI/CBC technicians was inserted before the input to the receiver, reducing the signal level to a point where defects begin to occur in the audio and confirming a consistent power level.

Calibration of the AT&T/Lucent IBAC system was performed at the base of Mt. Beacon immediately after the receiver power-up routine conducted by Lucent technicians. The switchable attenuator included in the RF test bed was used to add increasing attenuation until the system began to fail.

Due to limited satellite time, locations that had a relatively unobstructed view to the west were selected near the beginning of each route to be used as calibration points for the VOA/JPL system. At each scheduled satellite transmission event start time, the VOA/JPL modem and audio decoder were activated and the modem signal level display was monitored for a consistent signal level indication.

Test System Operation

After the individual system calibrations, the van was driven to the beginning of a long path test route. Before reaching the beginning of the route, the test operator would insert SMPTE timecode prestriped Hi-8 tapes into the two DA-88 8-track digital audio recorders and a prestriped SVHS tape into the main video recorder. A blank standard VHS tape was also inserted into the backup VCR. The EIA data collection software was then started and menu selections were made to specify the system under test, test route, current weather conditions, and operator group.

The main VCR was then set to output the mono audio track (containing the SMPTE timecode) and the "Play" button was pressed. When the timecode reader began to display incrementing timecode, the "Pause" button on the VCR was pressed. The "Start" button on the software was clicked, the landmark file selection confirmed, and a filename was entered for the collected data. The software would then begin collecting RF level data with each pulse of the shaft encoder and display each block of records in the on-screen strip chart as it was written to the hard drive.

The "Insert" button on the software was then clicked, and the VCR would begin to record video while playing the existing timecode track. The timecode reader, keyer display on the video monitor, and timecode window on the computer monitor were then checked for proper display and synchronization, and recording was started on the backup VCR. Both DA-88 "Play" buttons were pressed and the units were set in chase mode. When the DA-88s locked up with the timecode on the other devices, all track record buttons were enabled and the "Record" button was pressed. The recording system was then ready to record test data.

Observers were then asked to check the red and yellow event buttons on their control paddles for proper operation, which the operator confirmed by observing the event indicators on the computer software. The route was driven while the observers listened to the decoded digital audio on headphones and marked audio defects and dropouts. The operator incremented landmarks with the computer software and took notes on any odd occurrences or problems with the recording system.

Once the route was completed, the "Stop" button on the software was clicked and all tapes were stopped and rewound. The tapes were checked for data and proper playback synchronization, then labeled and write-protected.

Post-Test System Shutdown

Upon returning to the staging area, the van was connected to shore power and the generators were shut down. The computer data files written during the day's test runs were then backed up onto two separate data tapes, and blank SVHS and Hi-8 tapes were prestriped with SMPTE timecode. Once the backups were completed, all tapes containing test data were removed for shipping to the data analysis location. Finally, all antennas were removed and the vehicle was parked in the garage bay and secured.

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Field Test transmission facilities

F-1 FCC FM Band experimental application (revised), October, 1995. COVER PAGE ONLY, full text supplied on request.

F-2 FCC L-Band experimental application, January, 1995 COVER PAGE ONLY, full text supplied on request.

F-3 VOA-JPL S-Band system description.

F-4 Transmission site logs (samples).

EXHIBIT E
ENGINEERING STATEMENT RE:
APPLICATION FOR CONSTRUCTION PERMIT
EXPERIMENTAL EIA DAR VHF FM BAND RADIO
FIELD TEST - SAN FRANCISCO, CA.
ELECTRONIC INDUSTRIES ASSOCIATION
WASHINGTON, D.C.
JANUARY, 1995

INTRODUCTION

This statement is prepared on behalf of the Electronic Industries Association (EIA) in support of an application for Construction Permit to operate an Experimental Broadcast Station, under Part 74 Subpart A of the Rules of the Federal Communications Commission (FCC Rules), in association with its ongoing investigation into Digital Audio Radio (DAR). All information contained in or attached to this statement is provided as specified in Part 74 Subpart A of the FCC Rules, or as required by FCC application Form 309, unless specifically stated otherwise herein.

NAME OF APPLICANT / OPERATOR

This request is made by, and the resulting experimental operation will be conducted by, the Electronic Industries Association. The full correspondence address is: EIA DAR Subcommittee, Attn. Ralph Justus, 2500 Wilson Blvd., Arlington, Va. 22201-3884, Phone: 703-907-7638, Fax: 703-907-7601.

NEED FOR EXPERIMENTAL OPERATION / BACKGROUND

The EIA is presently conducting laboratory tests and is planning to conduct field tests of various proposed Digital Audio Radio (broadcast) systems. The laboratory testing is designed to simulate actual operation to the extent possible but all proponents

EXHIBIT E
ENGINEERING STATEMENT RE:
AMENDMENT TO APPLICATION FOR EXPERIMENTAL PERMIT
EIA-DAR L-BAND RADIO CHANNEL FIELD TEST
FCC FILE NO.4615-EX-PL-95, SAN FRANCISCO, CA.
ELECTRONIC INDUSTRIES ASSOCIATION
WASHINGTON, D.C.
OCTOBER, 1995

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FIGURES

Prepared by
Lohnes and Culver Washington, D.C.
October, 1995

LINK BUDGET FOR LINE-OF-SIGHT DIGITAL AUDIO BROADCASTING RECEPTION AT S-BAND (2.05 GHZ)		
AUDIO BIT RATE (Stereo)	160.00	kbps
Satellite transmitter power	7.00	watts
Satellite transmitter power	8.45	dBW
Frequency	2.05	GHz
Satellite antenna diameter	5.00	m
Satellite antenna gain	38.02	dBi
Satellite antenna beamwidth	2.05	deg
EIRP	46.47	dBW
Satellite Elevation Angle	25.00	deg
Slant Range	39262	km
Free space loss	-190.51	dB
Atmospheric losses	0.25	dB
(Total PFD in 200 kHz BW)	-116.40	dBW/m2
PFD in 4 kHz	-133.39	dBW/m2
Signal at Antenna	-144.29	dBW
Receive Antenna gain	8.00	dBi
Receive Antenna Pointing Loss	1.00	dB
Received Signal	-137.29	dBW
Antenna Temperature	150	K
Receiver Noise Figure	1.50	dB
Receive System noise temperature	274	K
Receive System G/T (On Antenna Axis)	-16.37	dB/K
C/No	66.94	dBHz
Bit Rate	52.04	dB
Eb/No Available	14.89	dB
Theoretical Eb/No, B.E.R.=10E-6	3.50	dB
Receiver implementation loss	1.00	dB
Interference degradation	0.50	dB
Receiver Eb/No Requirement	5.00	dB
LINK MARGIN, Beam Center	9.89	dB
LINK MARGIN, Beam Edge	6.89	dB

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R.F. - graphical information detail and unusual events
(specific samples and expanded view series)
Item; Path & Span; Description

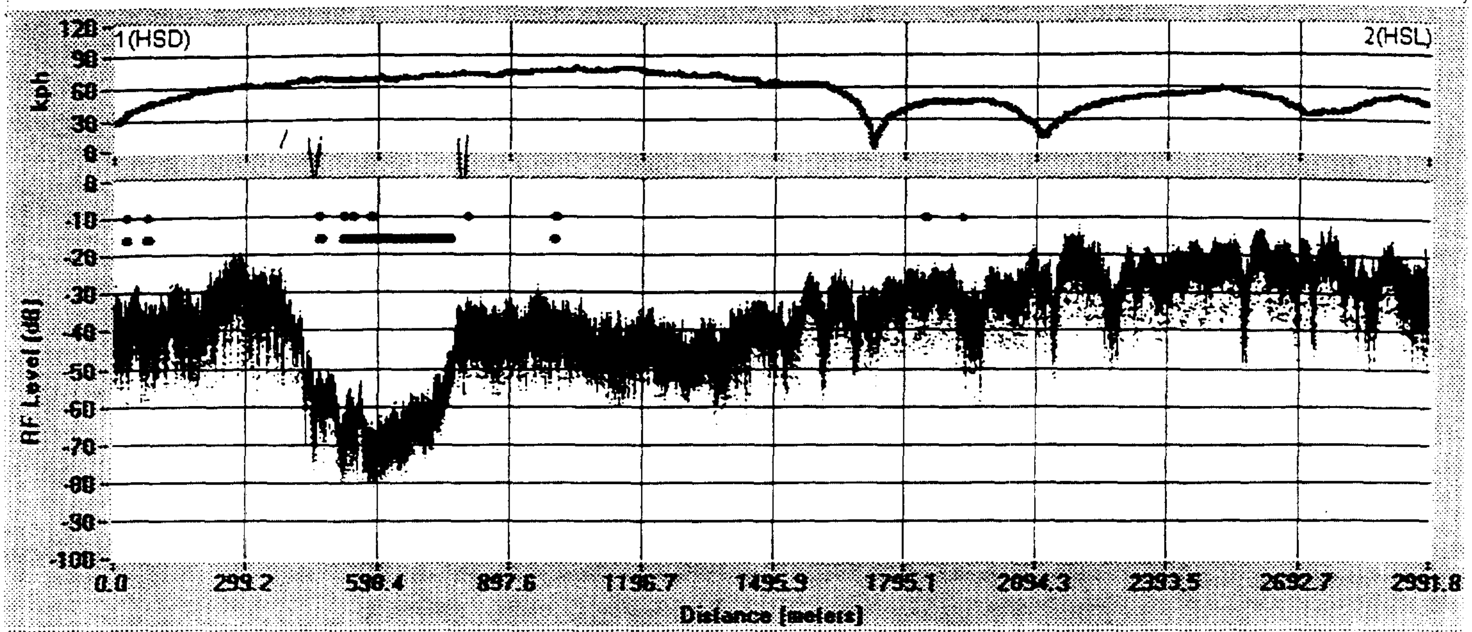
G-1 VHF System; Route P Landmark 1-2 and sections; Multipath standing waves with expansion showing detail, data structure and unusual event at entrance to tunnel.

G-2 L-Band System; Route P Landmark 1-2 and sections; Expansion showing event at entrance to tunnel.

G-3 VHF System; Route D Landmark 18-19 and sections; Multipath standing waves with expansion showing details.

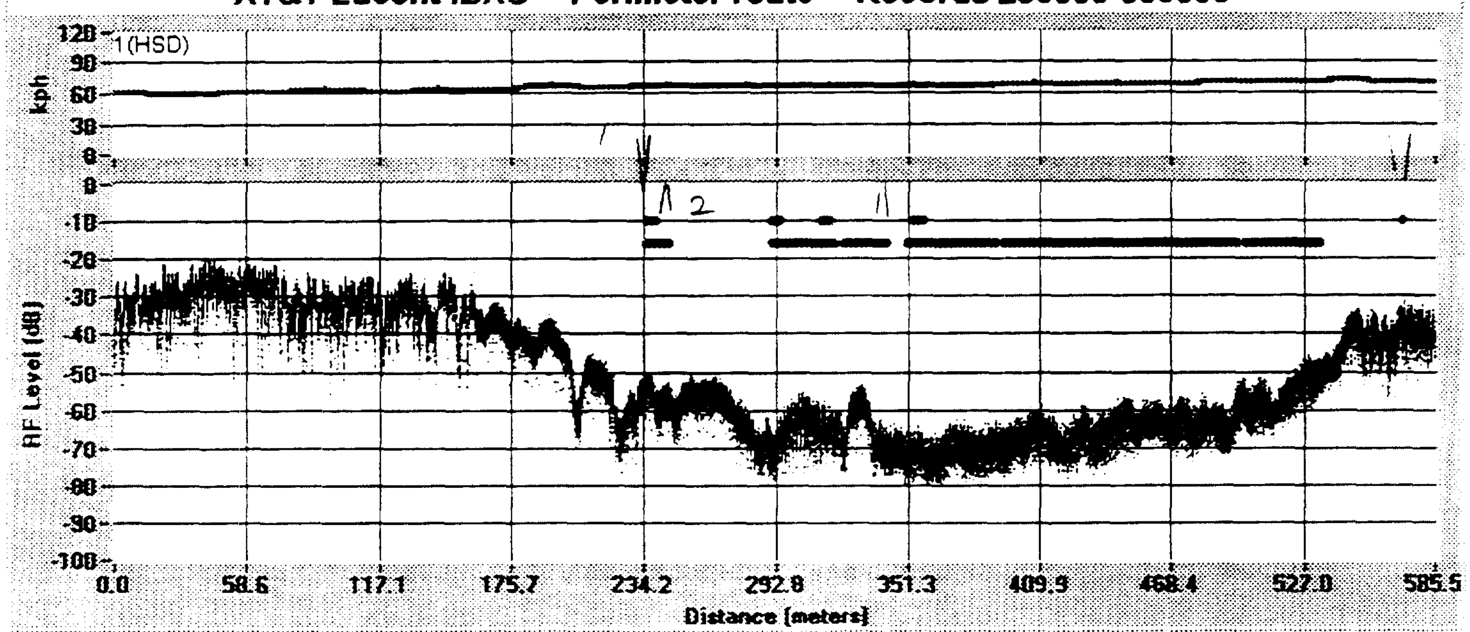
G-4 L-Band System; Route S Landmark 2-3 central section; Over water path with R.F. fading event.

AT&T Lucent IBAC -- Perimeter route -- Landmarks 1-2

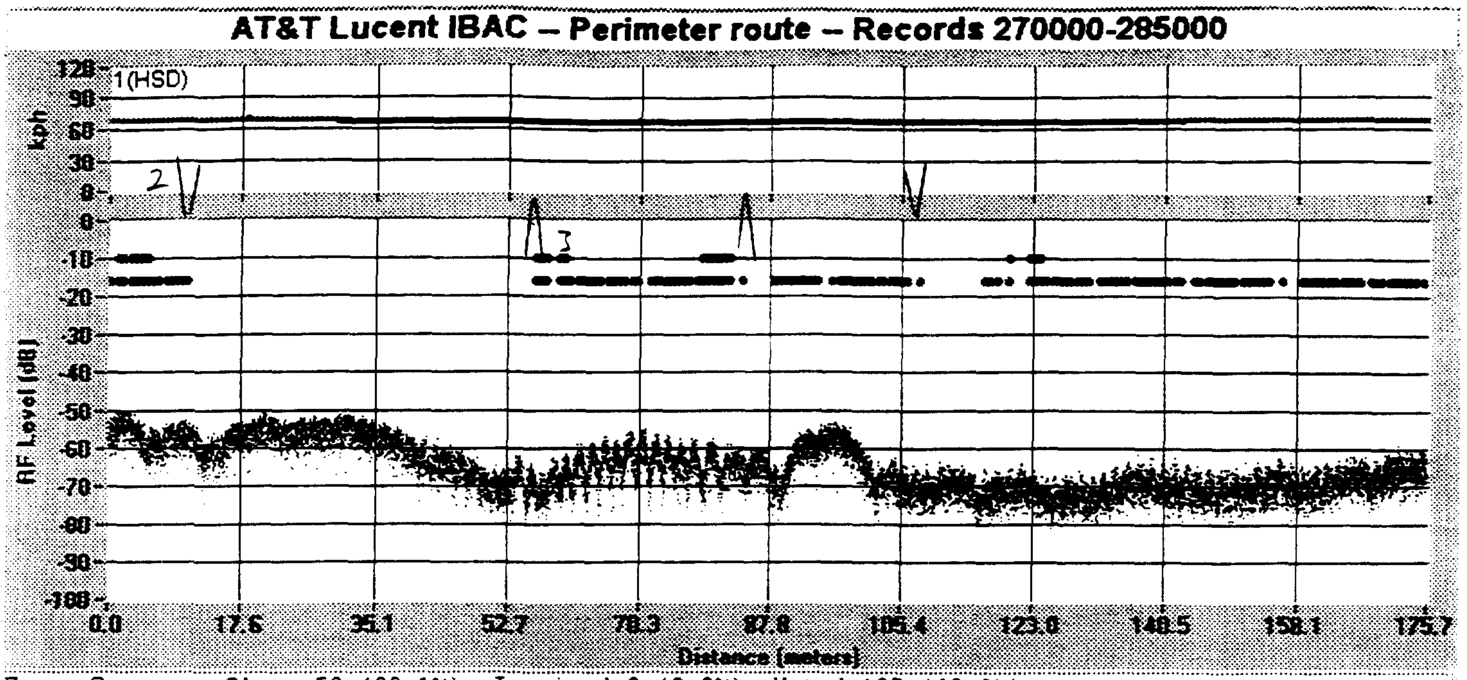


Event Summary: Clear 4488 (93.3%); Impaired 0 (0.0%); Muted 321 (6.7%)

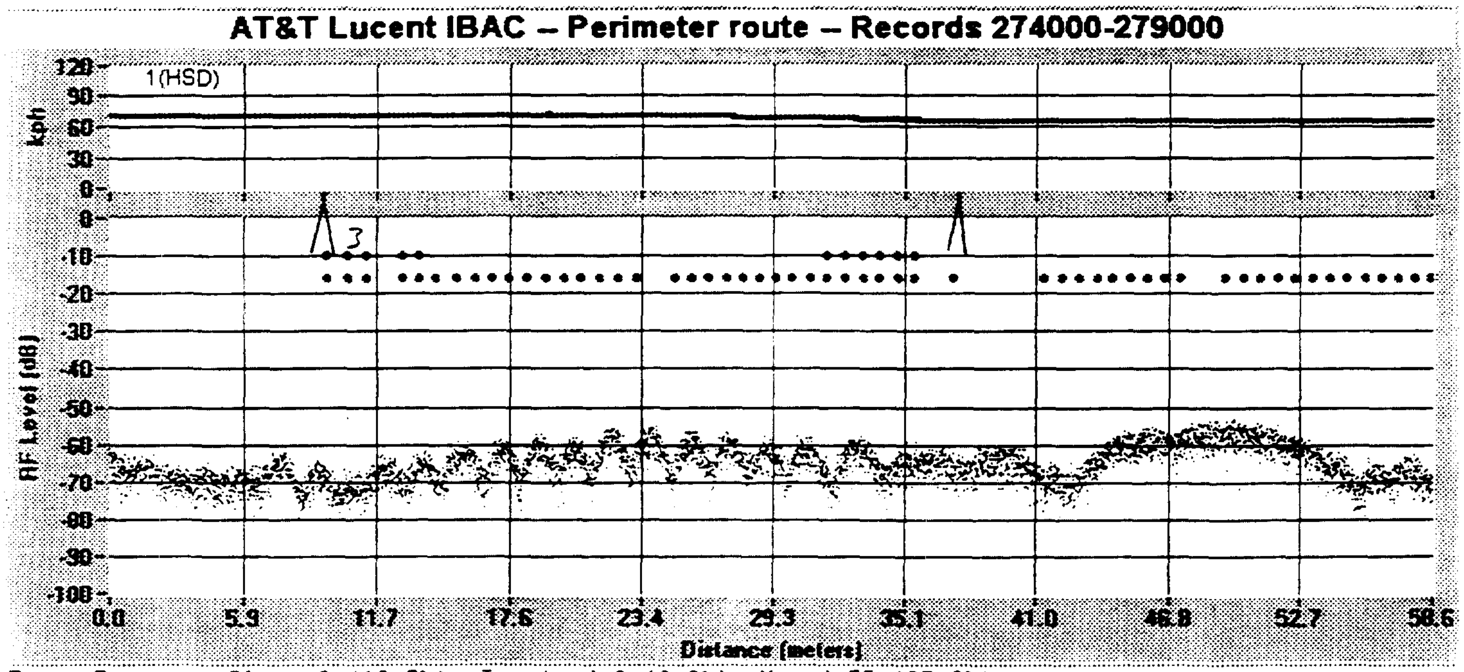
AT&T Lucent IBAC -- Perimeter route -- Records 250000-300000



Event Summary: Clear 397 (59.2%). Impaired 0 (0.0%). Muted 274 (40.8%).

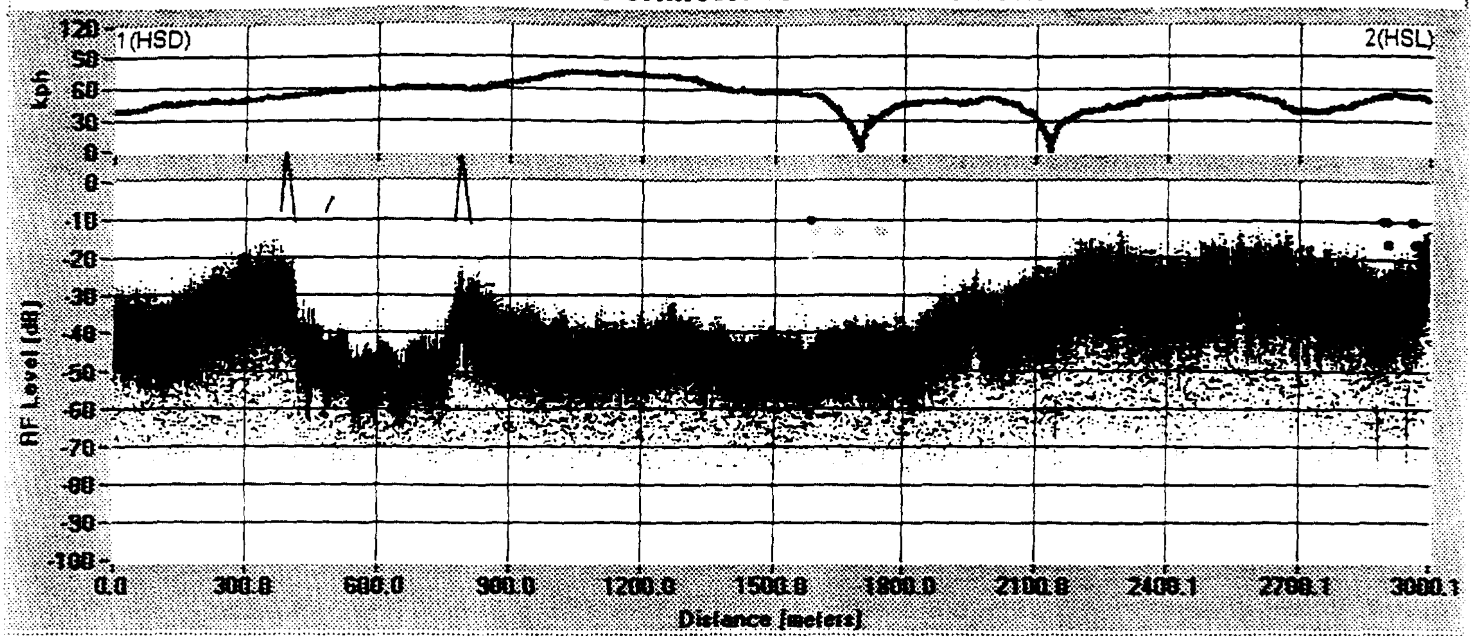


Event Summary: Clear 59 (30.1%); Impaired 0 (0.0%); Muted 137 (69.9%).



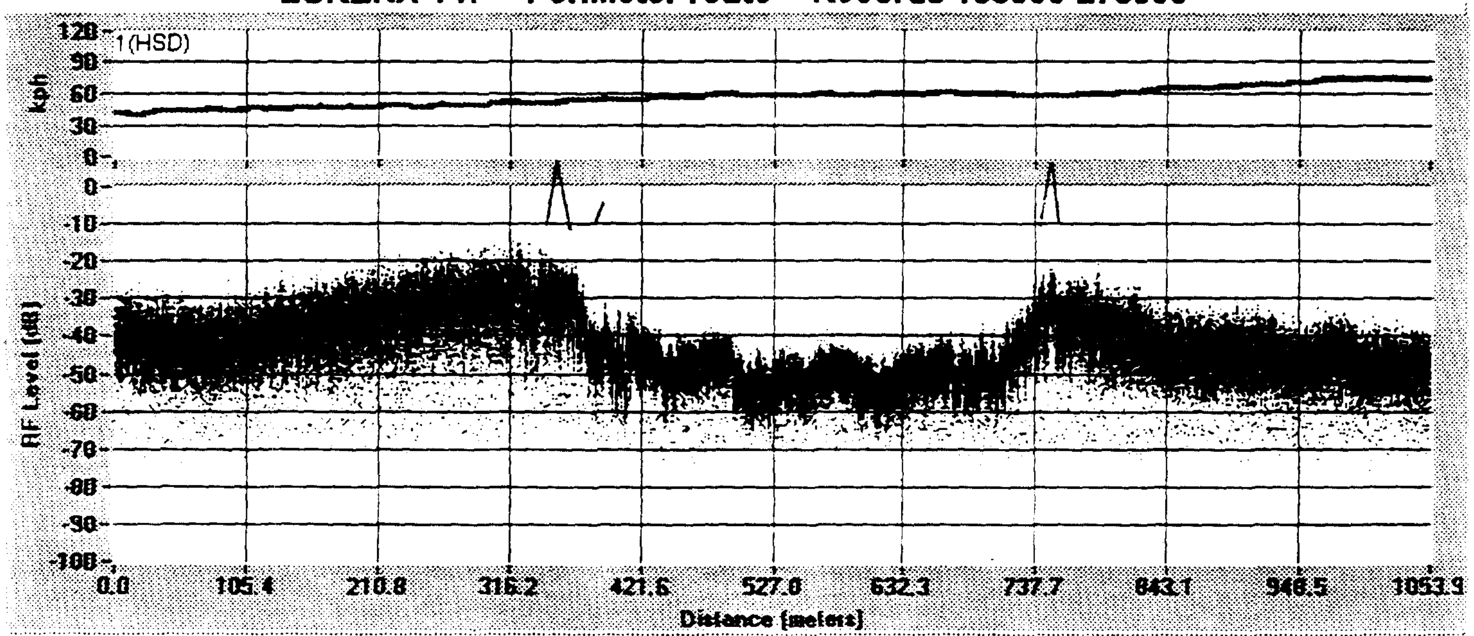
Event Summary: Clear 8 (12.7%). Impaired 0 (0.0%). Muted 55 (87.3%).

EUREKA-147 -- Perimeter route -- Landmarks 1-2

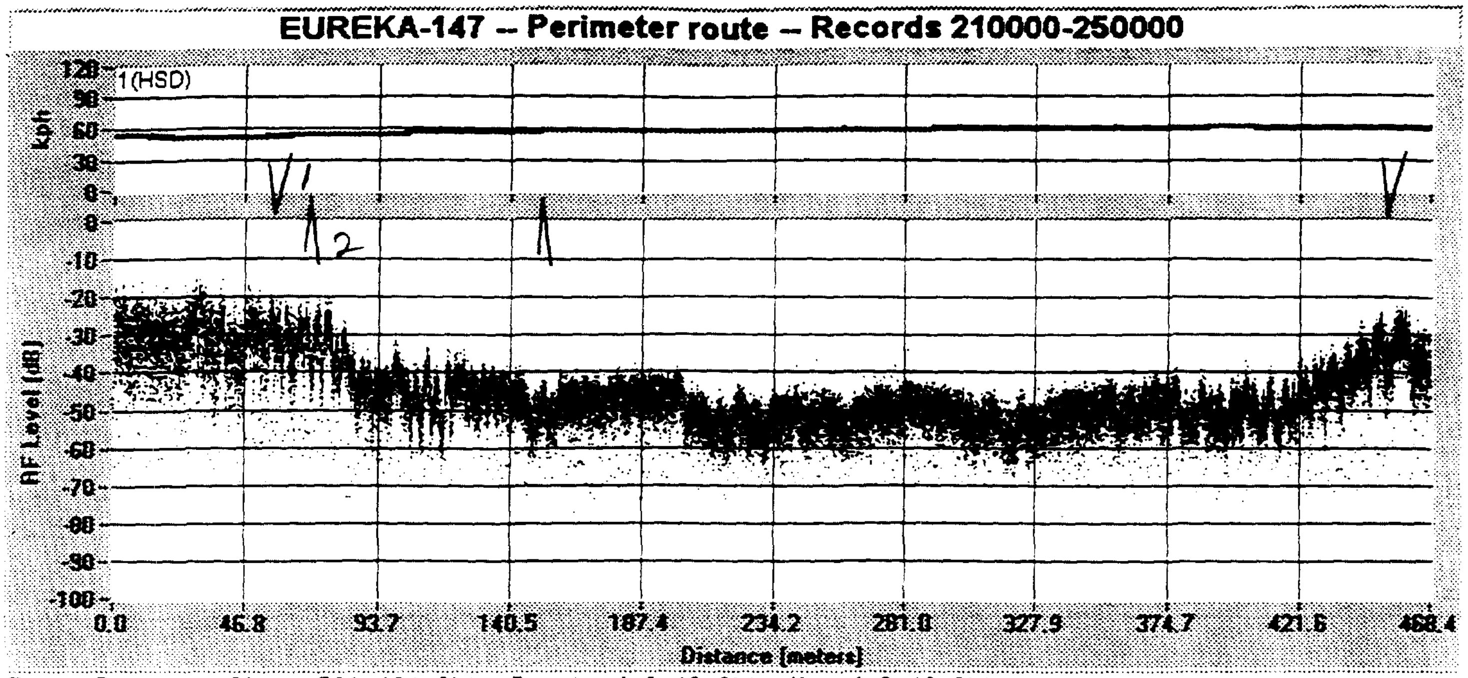


Event Summary: Clear 5230 (97.8%); Impaired 35 (0.7%); Muted 49 (0.9%)

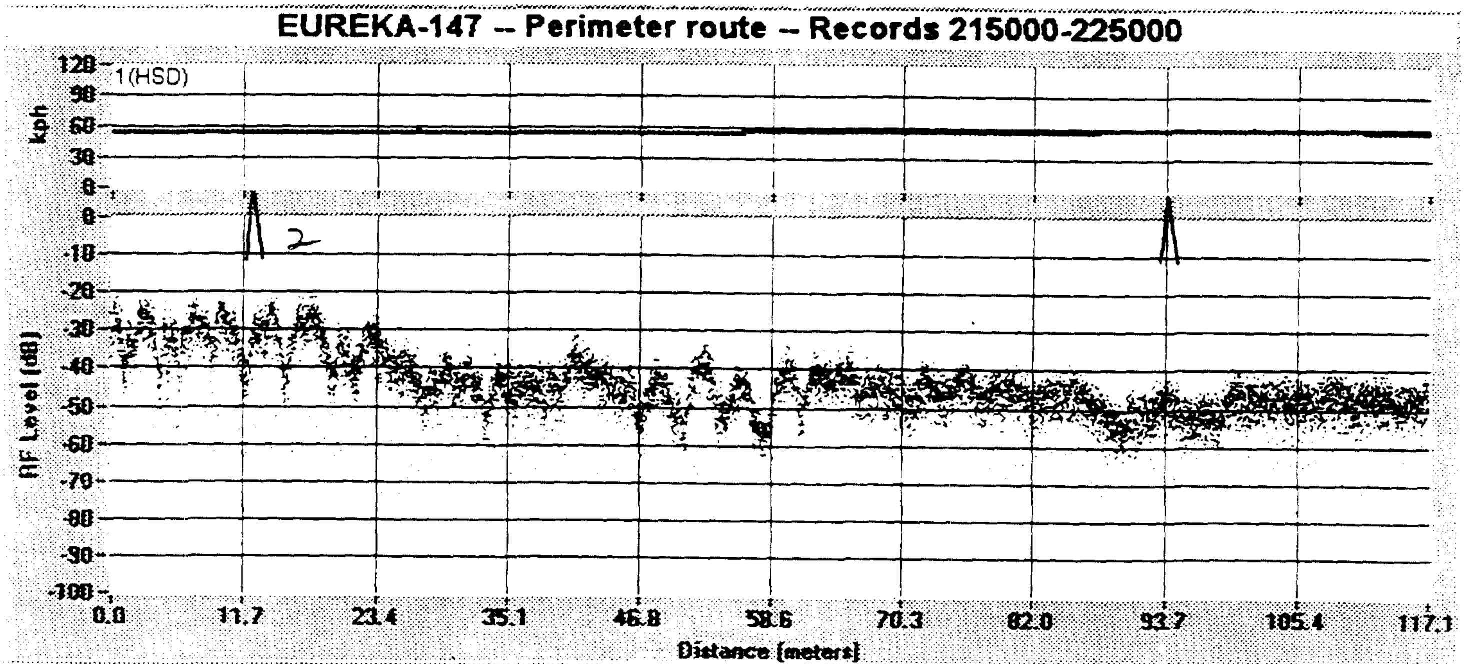
EUREKA-147 -- Perimeter route -- Records 185000-275000



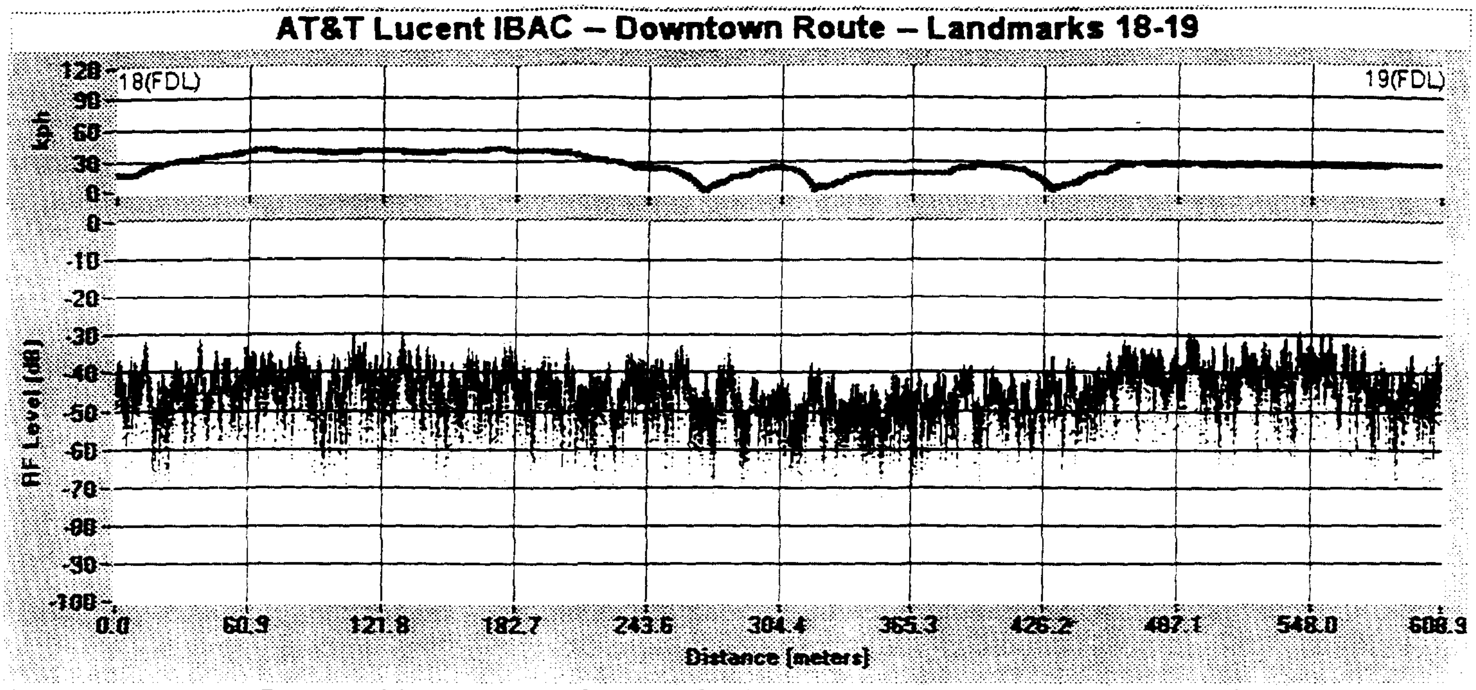
Event Summary: Clear 1412 (97.4%); Impaired 0 (0.0%); Muted 0 (0.0%)



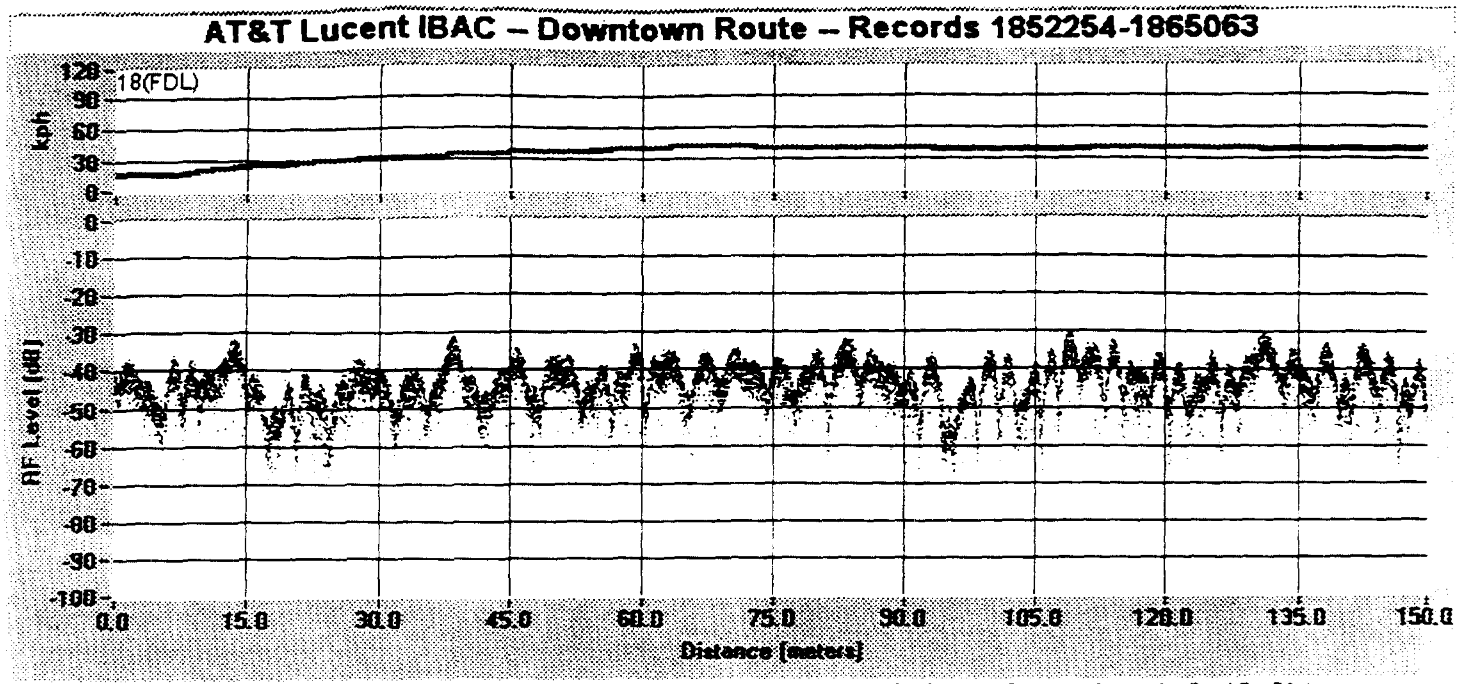
Event Summary: Clear 581 (94.0%), Impaired 0 (0.0%), Muted 0 (0.0%)



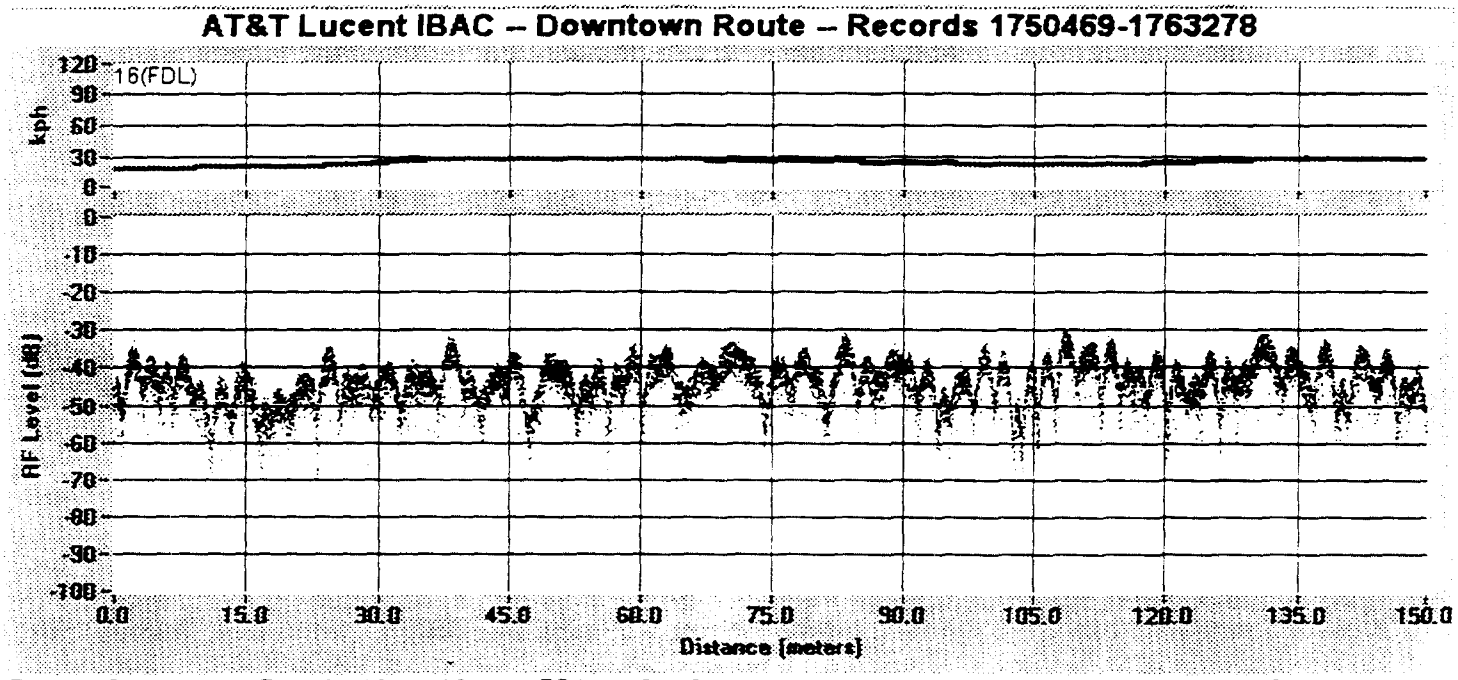
Event Summary: Clear 163 (100.0%), Impaired 0 (0.0%), Muted 0 (0.0%)



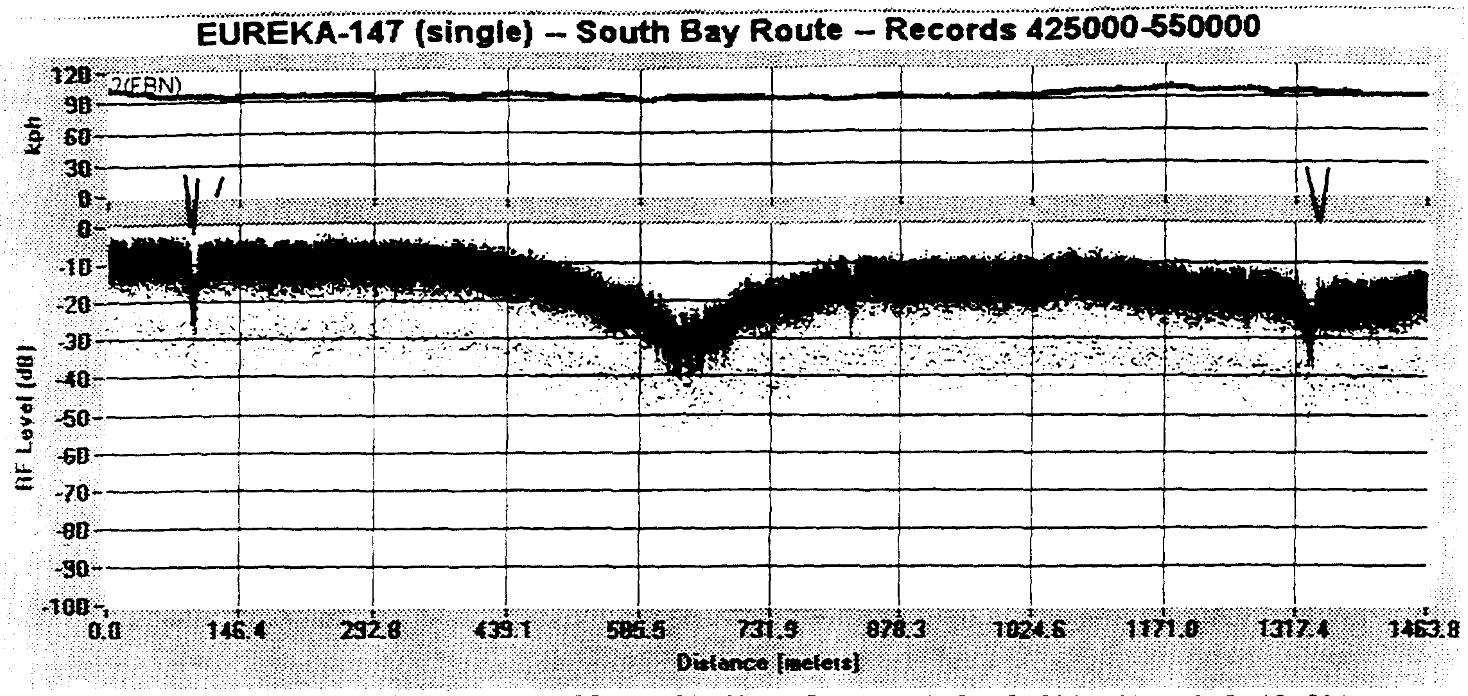
Event Summary: Total 2621; Clear 2621 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).



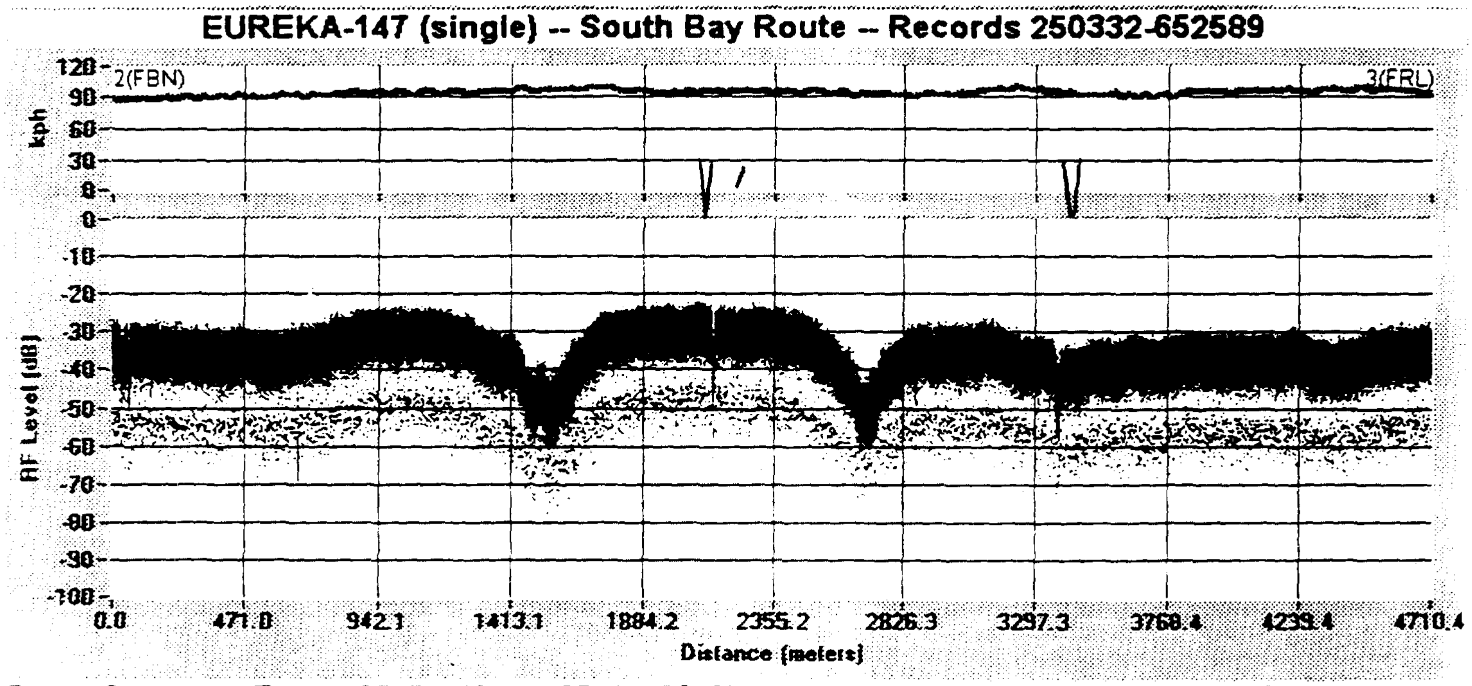
Event Summary: Total 360; Clear 360 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).



Event Summary: Total 521; Clear 521 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).



Event Summary: Total 1091; Clear 1091 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).



Event Summary: Total 3517; Clear 3512 (99.9%); Impaired 5 (0.1%); Muted 0 (0.0%).

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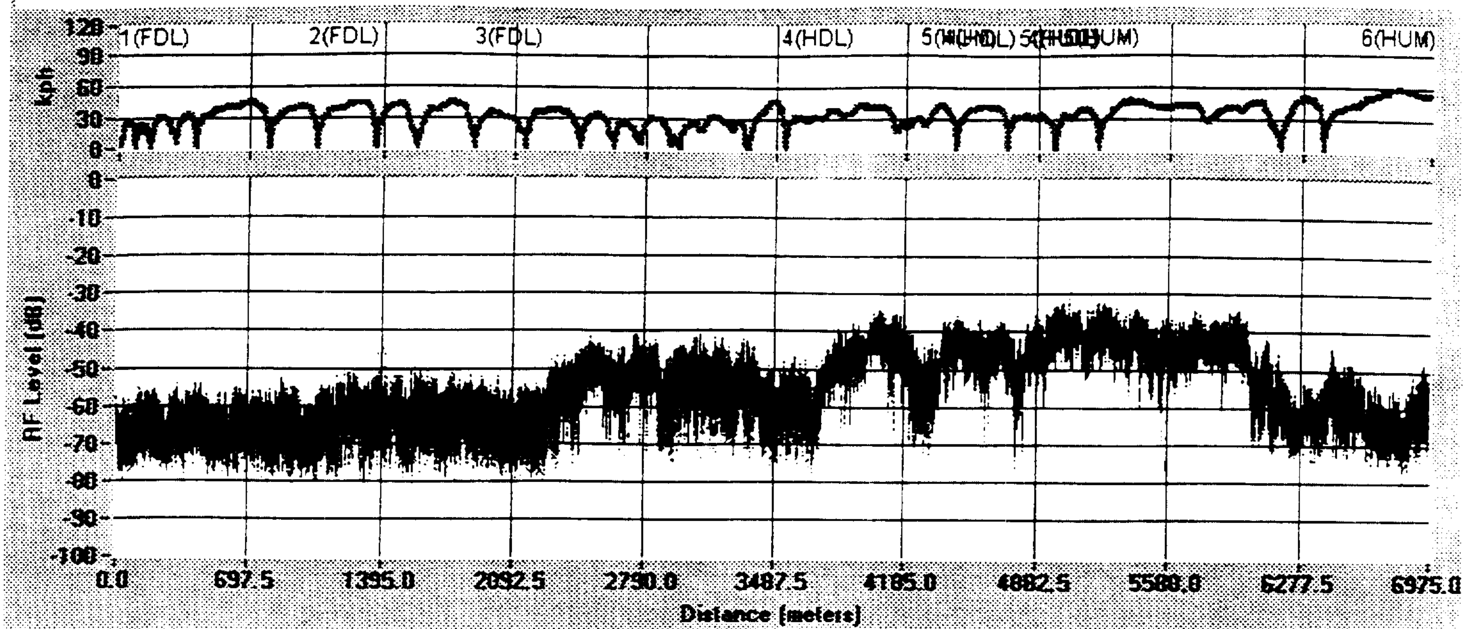
VHF Interference Survey

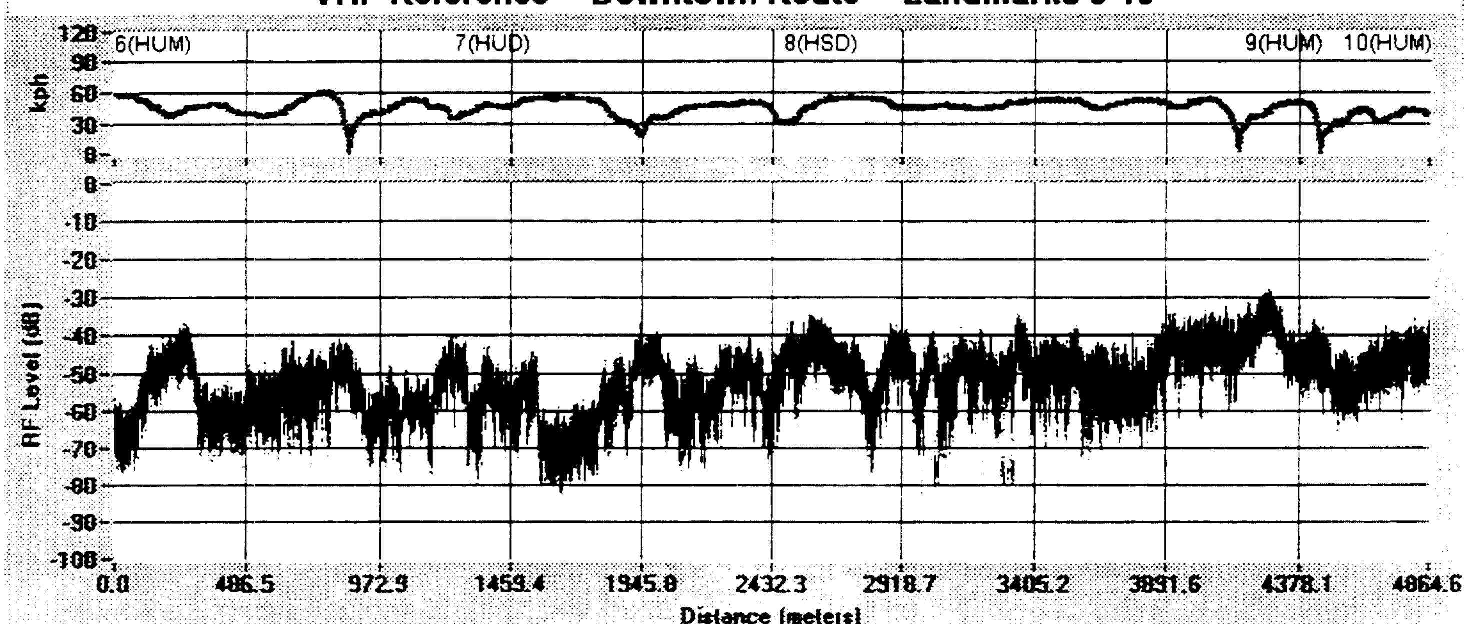
Continuous recording of the background R.F. at the VHF test frequency, using the same equipment and method as for the VHF proponent testing, without the VHF test transmitter active.

VHF Reference -- Downtown Route -- Landmarks 1-6



Event Summary: Total 22924; Clear 22924 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).

VHF Reference -- Downtown Route -- Landmarks 6-10



Event Summary: Total 9323; Clear 9323 (100.0%); Impaired 0 (0.0%); Muted 0 (0.0%).